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Original Article

POSTURE AND BALANCE IN ELDERLY WHO PRACTICE AND WHO DO NOT PRACTICE PHYSICAL ACTIVITIES

POSTURA E EQUILÍBRIO EM IDOSOS PRATICANTES E NÃO PRATICANTES DE EXERCÍCIOS FÍSICOS

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RESUMO

Esse estudo teve como objetivo comparar a postura corporal e o equilíbrio entre idosos praticantes e não praticantes de exercícios físicos. Trata-se de um estudo transversal e analítico, com uma amostra por conveniência de 245 idosos, distribuída em grupo de praticantes de exercício físico (GP) (n=169) e grupo de não praticantes de exercícios físicos (GNP) (n=76). O equilíbrio foi avaliado pela escala de Berg, a postura corporal ortostática por meio do *software* SAPO e a postura sentada pelo protocolo Rocha e Souza. Foi encontrado que os idosos do GP possuem melhor postura sentada (p = 0,046), alinhamento vertical do tronco direito (p = 0,039), alinhamento vertical do corpo direito (p = 0,027) e esquerdo (p = 0,004), ângulo do tornozelo esquerdo (p = 0,023), assimetria do plano frontal (p = 0,008) e equilíbrio (0.001), comparados aos idosos do GNP. Conclui-se que os idosos que praticam exercícios físicos apresentam melhor postura e equilíbrio, em comparação aos não praticantes. Essas informações podem ser úteis para aumentar e incentivar programas de práticas corporais e exercícios físicos para idosos no Brasil.

Palavras-chave: Atividade motora. Exercício Físico. Envelhecimento. Equilíbrio. Promoção da Saúde.

ABSTRACT

This study aimed to compare body posture and equilibrium between the elderly who practice and who do not practice physical activities. This is a cross-sectional and analytical study, with a convenience sample of 245 elderly people, divided into practicing group of physical activity (PG) (n=169) and non-practicing group of physical activity (NPG) (n=76). The balance was evaluated using the Berg scale and the orthostatic body posture through SAPO software and the seated posture by the Rocha and Souza protocol. It was found that the elderly of the PG had better-seated posture (p=0.046), vertical alignment of the right trunk (p=0.039), vertical alignment of the right (p=0.027) and left (p=0.004) left ankle angle (p=0.023), asymmetry of the frontal plane (p=0.008) and balance (p=0.001), compared to the elderly of NPG. It is concluded that the elderly who practice physical activities have better posture and equilibrium, compared to non-practicing ones. This information can be useful to increase and encourage physical practices and physical activities for the elderly programs in Brazil.

Keywords: Motor activity. Exercise. Aging. Balance. Health promotion.

Introduction

Regardless of age, posture has considerable consequences for the body's health and well-being, as it provides the distribution of effort on bones, muscles, tendons, ligaments, and discs. This effort is minimal if the posture is adequate and well distributed. Inadequate or incorrect posture overloads the most fragile structures, increasing the total effort. In the orthostatic posture, inadequate posture overloads the hips, knees, ankles and distributes excessive weight on the feet, which can affect walking. When adopted for long periods, it can lead to chronic pain[1].

With age advancement, the degree of body oscillation-imbalance increases even in simple postures, such as in orthostatic posture, causing the elderly to become more unbalanced than young adults[2]. Changes in the sensory system due to aging also affect the

reaction time, causing the elderly to have balance-related disorders[3]. These changes can lead to falls, fear of falling, dependency, institutionalization and even death[4].

In this context, it is central to understand the postural changes related to the aging process and its clinical and functional consequences for the development of elderly care strategies, also for health and education improvement. These actions can reduce the number of falls and improve the quality of life of this population[5]. Regular practice of a physical activity is suggested among the actions for the improvement in the elderly balance[6].

Understanding the level of the population's physical activity has been the aim of many researchers worldwide as a way of identifying the impact of a sedentary lifestyle on different organs and systems of the human body. However, data on physical activity level and static body posture in the elderly are still scarce. Thus, the production of evidence that shows the importance of physical exercise by the elderly population is certainly relevant[7]and understanding the postural profile of the elderly who regularly practice physical exercises can support the discussion on the priority themes of the National Health Promotion Policy. This study considers the hypothesis that despite the potential engagement in the promotion of physical activity observed recently, elderly who regularly practice physical activities show better scores in the evaluation of posture and balance, compared to those that do not practice them. This way, the objective of this study was to compare body posture and balance between elderly who regularly exercise with those who do not practice them regularly.

Methods

This is a cross-sectional and analytical study according to Marques and Peccin[8], carried out after approval by the Research Ethics Committee of the Cesumar University (Unicesumar), registered with number 1,401,288. The convenience sample was composed of elderly people informed about the objectives and procedures to be performed, according to the guidelines for research with human beings, included in Resolution 466/2012 of the National Health Council of Brazil. After these procedures, all participants signed the Informed Consent Form (ICF).

The sample consisted of volunteers who attended two institutions that offer activities to the elderly population in the city of Maringá-PR (Elderly Open University at Universidade Estadual de Maringá and Commerce Social Service of Maringá). Elderly men and women from 60 to 80 years old were included. Elderly who needed mobility device assistance and those with cognitive impairments assessed by the Mini Exam of Mental State (MMSE) were excluded from the study[9]. People with a score below 19 points were excluded[10].

A semi-structured questionnaire was used to characterize the sample, composed of information on age, sex, marital status, education, monthly income, and physical activity. The elderlies were divided into a Practicing Group (PG) and a Non-Practicing Group (NPG) of physical exercises. The elderly in the Practicing Group (PG) had been practicing different types of physical activities for at least six months, such as water aerobics, gymnastics, Pilates, weightlifting, walking and functional training (information self-reported by the elderly). The elderly of the Non-Practicing Group (NPG) self-declared not to practice any type of physical activity.

The anthropometric variables measured were body mass, height, and body mass index (BMI). Body mass index (BMI) was obtained by dividing body mass (kg) by height (m^2), obtaining a result in Kg/m^2. According to the Pan American Health Organization[11], the body mass index (BMI) of the elderly is classified as low weight (score below 23 kg / m^2); normal (23-28 kg/m^2); overweight (28-30 kg/m^2; and obesity (over 30 kg/m^2).

To compare the level of physical activity of the elderly, the International Physical Activity Questionnaire (IPAQ) was used, in its short version, adapted by Matsudo et al.[12]. The

questionnaire evaluates the frequency, in days, and the duration, in minutes, of the activities performed such as leisure, occupation, mobility and household activities during the week. To classify the physical activity levels, a consensus was used between the Study Center Laboratory of Physical Aptitude (Celafiscs) and the Center for Disease Control[13]. The questionnaire was applied by interview.

The Rocha and Souza protocol[14] was used to evaluate sitting posture. This protocol has four criteria: maintenance of spinal curvatures; sit closer to the table; maintenance of the neutral positioning of the pelvis supported by the ischium; and sit with the lower limbs apart, equal to or beyond the hip line. One point is given to each criterion achieved up to a maximum score of four points. The protocol was applied by the evaluator's observation, during the period in which the elderlies were responding to MMSE[8]. However, this observation took place before the explanation of the research objectives and methods, so that there was no interference in the participants' posture.

Orthostatic posture was evaluated by photogrammetry, an approved method of postural evaluation and one of the literature's most used. Pictures of the study participants were taken of anterior, lateral, and posterior positions. For the evaluation, it was used polystyrene balls (25 mm), double-sided adhesive tape, plummet, digital camera (Nikon, model Coolpix L120, 14.1MP) and tripod leveled with the ground. First, anatomical delimitation was made, according to the Postural Analysis Software (PAS/SAPo)[15]. This software was developed specifically for the analysis of pictures aimed at health purposes and allows categorization and comparison of pictures to observe the patient's evolution. The protocol has 32 anatomical points. After anatomical spotting, the elderly man was placed in an orthostatic position and a photo was taken in each view: anterior, right lateral, left lateral and posterior[15]. After the evaluation, the pictures were analyzed on a computer by Postural Analysis Software (PAS/SAPo), version 0.68. The software provides measurements in the anterior, lateral, and posterior positions from the anatomical delimitation. The software also calculates the projection of the center of gravity, related to the support base, originating from the projection of the medial position between the lateral malleolus. This analysis generates two measures: asymmetry in the frontal plane and asymmetry in the sagittal plane[15].

Body balance was evaluated using the Berg scale[16]. The instrument was designed to evaluate balance in 14 items typical to daily life. The maximum score that can be achieved is 56 and each item has an ordinal scale of five alternatives, ranging from zero to four points. A score below 45 points indicates the risk of falls. A chronometer, measuring tape, a chair with and without an arm and a step were used for the evaluation.

Quantitative variables were described by standard deviations and coefficients of variation (CV). The characterization of the sample, concerning body posture, the practice of physical activities and other categorical variables were performed by frequency charts. The association between exercising and non-exercising and observed variables was tested using the Chi-square test ($\chi 2$). The Shapiro-Wilk test was used to analyze the normality of the data and then compare the orthostatic posture and sitting and the balance of the groups, the Wilcoxon test was applied, approaching the normal distribution (Z). All calculations were performed using Statistical Analysis Software - SAS, version 9.3. For all tests, a significance level of 5% ($\alpha = 0.05$) was considered.

Results

A total of 255 elderly people was evaluated, from which ten of them were excluded for not meeting the inclusion criteria. Thus, 245 elderly people with a mean age of 68.67 years old ± 5.01 years constituted the sample (Figure 1). A total of 169 elderly people was included

in the PG, with an average age of 68.81 years old ± 4.90 years and the NPG was composed of 76 elderly people, with an average age of 68.35 years old ± 5.27 years.

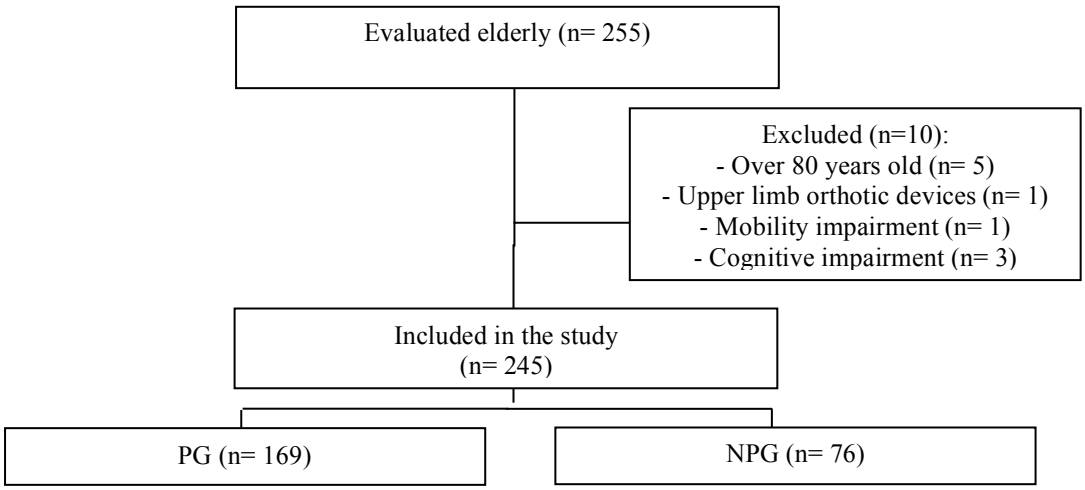

Figure 1. Distribution of the elderly participants in the study
Source: The authors

Sociodemographic characteristics are described in Table 1. The groups were similar in the age (p = 0.112) and BMI (p = 0.335) items.

Table 1. Distribution of the attendance rates of the elderly in the physical exercise practicing group (PG) and non-practicing group (NPG), regarding sociodemographic aspects

Variables		PG (n=169)	NPG (n=76)	p
		N (%)	N (%)	
Gender	Female	140 (82.84%)	61 (80.26%)	0.125
	Male	29 (17.16%)	15 (19.74%)	
Marital Status	Married	70 (41.42%)	28 (36.84%)	
	Single	21 (12.43%)	12 (15.79%)	0.761
	Divorced	29 (17.16%)	15 (19.74%)	
	Widowed	49 (28.99%)	21 (27.63%)	
Education	Up to 8 years of study	48 (28.40%)	26 (34.21%)	0.625
	9 to 11 years of study	71 (42.01%)	28 (36.84%)	
	12 or more years of study	50 (29.59%)	22 (28.95%)	
Monthly income	1 to 2 minimum wages	67 (39.65%)	31 (40.79%)	
	2 to 4 minimum wages	54 (31.95%)	29 (38.16%)	0.269
	4 to 6 minimum wages	29 (17.16%)	6 (7.89%)	

Note: *Significant difference (p <0.05) - chi-square test. Values are presented as the number of participants (N) and percentage (%)
Source: The authors

Table 2 shows that the groups reached different results concerning the level of physical activity, according to the IPAQ. The number of elderly people in the NPG group who were classified as irregularly active or sedentary (27.63%) is more than twofold of those observed for the PG (12.43%), indicating that the elderly in the NPG group are generally less active than those of the PG Group.

Table 2. Physical activity level of elderly people who practice physical exercises (PG) and Non-Practicing Group (NPG), according to IPAQ

IPAQ Classification	PG (n=169)	NPG(n=76)	p
	N (%)	N (%)	
Very active	17 (10.06%)	4 (5.26%)	0.024*
Active	131 (77.51%)	51 (67.11%)	
Irregularly active	18 (10.65%)	17 (22.37%)	
Sedentary	3 (1.78%)	4 (5.26%)	

Note: *Significant difference (p <0.05) - Chi-square test. Values are presented as the number of participants (N) and percentage (%). IPAQ: International Physical Activity Questionnaire
Source: The authors

In sitting posture evaluation, it was observed that the PG group had better results compared to the NPG group (p = 0.046). In the evaluation of orthostatic level with photogrammetry, better results (p <0.05) were observed in the PG group in the variables: vertical alignment of the right-side trunk, vertical alignment of the right and left body, angle of the left ankle and asymmetry of the frontal plane (Table 3).

Table 3. Comparison of orthostatic posture among practicing group (PG) and non-practicing group (NPG) of physical activities

Variables	PG(n=169)	NPG(n=76)	P
	Md (Q1-Q3)	Md (Q1-Q3)	
Anterior View			
Horizontal head alignment (g)	2.30 (1.10-4.00)	2.50 (1.25-4.60)	0.309
Horizontal alignment of acromions (g)	1.70 (0.80-2.90)	1.60 (0.80-3.10)	0.454
Horizontal alignment of the anterior superior iliac spine (g)	1.60 (0.70-2.50)	1.55 (0.75-2.60)	0.389
Angle between 2 acromions and 2 anterior superior iliac spine (g)	1.70 (0.90-3.60)	2.00 (1.05-3.80)	0.180
Anterior alignment of the right lower limb (g)	4.00 (2.20-6.40)	3.80 (1.45-6.20)	0.187
Anterior alignment of the left lower limb (g)	3.60 (2.20-5.70)	3.50 (1.50-5.60)	0.228
Difference of lower limbs in length (cm)	0.90 (0.50-1.60)	1.00 (0.40-1.60)	0.431
Horizontal alignment of tibial tuberosities (degrees)	1.50 (0.60-3.00)	1.75 (0.50-3.15)	0.392
Right Q-angle (g)	18.70(11.70-27.20)	18.75 (10.90-28.95)	0.389
Left Q-angle (g)	23.30(15.00-32.70)	22.50 (15.80-29.60)	0.195
Posterior View			
Horizontal asymmetry of scapulae related to T3 (%)	19.00 (8.50-35.10)	19.20 (7.45-31.50)	0.366
Right leg / rearfoot-to-leg angle (g)	6.00 (3.25-10.20)	7.50 (3.05-12.15)	0.085
Left leg / rearfoot-to-leg angle (g)	6.40 (3.40-10.05)	8.25 (3.80-11.30)	0.087
Right Side View			
Horizontal head alignment (C7) (g)	46.10 (41.70-50.70)	47.10 (42.10-52.25)	0.282
Vertical head alignment (acromions) (g)	15.50 (10.00-21.70)	18.10 (9.40-24.10)	0.279
Vertical body trunk alignment (g)	2.60 (1.40-4.10)	3.10 (1.75-4.80)	0.039*
Hip angle (trunk and lower limb) (g)	9.90 (3.00-12.50)	10.35 (6.05-13.55)	0.283
Vertical body alignment (g)	1.95 (1.10-2.90)	2.30 (1.50-3.20)	0.027*
Horizontal alignment of the pelvis (g)	8.90 (4.10-11.60)	8.50 (4.60-15.45)	0.081
Knee angle (g)	4.60 (2.70-7.90)	4.70 (2.60-7.85)	0.391
Ankle angle (g)	86.30 (84.20-88.60)	87.15 (84.50-88.85)	0.142

Continuation of Table 3

Left side view			
Horizontal head alignment (C7) (g)	43.60 (39.70-48.40)	43.50 (38.95-47.45)	0.252
Vertical head alignment (acromions) (g)	18.00 (10.00-26.10)	17.85 (9.45-28.65)	0.446
Vertical body trunk alignment (g)	3.10 (1.40-5.00)	3.40 (2.05-4.80)	0.362
Hip angle (body trunk and lower limb) (g)	8.50 (5.40-11.90)	9.55 (5.80-12.70)	0.201
Vertical body alignment (g)	1.50 (0.60-2.60)	2.00 (1.05-3.40)	0.004*
Horizontal alignment of the pelvis (g)	8.50 (5.10-11.80)	8.85 (3.10-14.10)	0.422
Knee angle (g)	3.90 (1.70-5.60)	4.00 (2.60-6.95)	0.129
Ankle angle (g)	85.45 (82.80-88.50)	86.60(84.20-88.80)	0.023*
Center of gravity			
Asymmetry in the frontal plane (%)	5.20 (2.40-10.00)	7.75 (3.85-11.50)	0.008*
Asymmetry in the sagittal plane (%)	35.90 (29.50-42.80)	38.65 (29.25-47.80)	0.076

Note: *Significant difference (p <0.05) - Wilcoxon test. Values are presented as median (Md) and interquartile range (Q1-Q3). ASIS: anterior superior iliac spine
Source: The authors

Regarding balance, considerable differences were found between the groups (Table 4).

Table 4. Comparison of balance between the practicing (PG) and non-practicing group (NPG) of physical activities

Variables	PG	NPG	P
	Md (Q1-Q3)	Md (Q1-Q3)	
Balance	**(n=169)**	**(n=76)**	
	55 (54-56)	54 (53-56)	0,001*

Note: *Significant difference (p <0.05) - *Wilcoxon* test. Values are presented as median (Md) and interquartile range (Q1-Q3)
Source: The authors

Discussion

Elderly that regularly practice physical activities revealed a tendency of better scores in the evaluation of sitting posture, vertical alignment, and balance, compared to non-practicing ones, partially confirming the hypotheses. These results are confirmed by previous studies[3,7,17]. Bertolini and Manueira[18] showed that elderly people who do not exercise have less balance and a greater history of falls.

The sitting posture is damaging and causes several changes in the muscle-skeletal structures of the spine. When a person moves from a standing position to a sitting position, intradiscal pressure increases by 35%, causing distress in the cervical region and the lower limbs. Sitting in incorrect postures for a long time increases alterations, with intradiscal pressure increasing to over 70%[22], which can affect muscle flexibility, joint mobility, and fatigue of the extensor muscles of the spine, which predisposes to pain and spinal injury[23].

The elderly people spend long periods in sitting position, on average five hours a day, which may be related to the fact that they are not included in formal work activities, dedicating more time to leisure[24]. Therefore, it is worth mentioning that, to reduce the consequences caused by sitting posture, it is crucial keeping the physiological curvatures of the spine and the neutral positioning of the pelvis[26] beside adequate appliance[25] with ergonomic components that reduce the mechanical burden on the spine [26].

In the sitting posture evaluation, it was found that the PG reached better scores. The practice of physical activities results in beneficial circulatory and metabolic adaptations for skeletal muscles and connective tissues, contributing to the improvement of static and

dynamic posture[27] led by the gain of muscle strength and flexibility, essential factors in maintaining good posture, especially regarding the maintenance of spinal curvatures[28].

For a good posture, it is necessary to move the muscles that work against the gravitational action and the supporting balance of each body segment, formed by the vertical axis of the head, trunk and alignment of the vertical projection of the center of mass in the support base[5]. No studies were found evaluating the sitting posture of the elderly. It is important to emphasize the necessity for more research about this evaluation since this population spends a good part of the day sitting and inadequate posture can lead to painful distress, reducing the quality of life.

When evaluating the orthostatic posture, notable differences were observed in the measurements: vertical alignment of the right trunk, vertical alignment of the right and left body, angle of the left ankle and asymmetry in the frontal plane. These results agree with those found by Nunes, Fonseca and Scheicher[29], who reported that the elderly who do not practice physical exercise are more likely to anteriorization and lateralization of the center of gravity. On the other hand, in the studies by Valduga et al.[30], there were no significant differences in posture between the elderly who practice and do not practice activities. Although this condition remains a multifactorial problem, it is possible that people with postural deficits, especially the elderly, may be unable to achieve adequate postural responses during long hours standing, for example. This fact can lead to fatigue and, ultimately, contribute to this population's fall risk[21].

The Berg scale evaluates the static and dynamic balance during the execution of motor skills, with items that are common to routine activities. Through this evaluation, it is possible to measure the ability to maintain different positions, to automatically respond to voluntary movements of the body and extremities and to react to external consequences, necessary skills in the daily activities of the elderly[20]. It is known that the strength declines due to physical inactivity or the aging process negatively affects the people´s functional capacity and, consequently, their balance[19].

The best balance scores in the PG can be explained by the fact that regular physical activity produces important morphological and neuromuscular adaptations, even at older ages. The loss of muscle strength due to aging has been attributed to sarcopenia, which is related to the loss of fibers types I and II, to the atrophy of fibers type II and the increase in intramuscular content of adipose and connective tissues. As falls are related, among other factors, to worse levels of muscle strength, this variable can be modified through physical exercise, further emphasizing its importance in preventing falls in this public[21].

The lowest level of physical activity was found in the NPG. These results imply that the practice of physical activities is necessary so that the elderly reach the current recommendation of physical activity for health promotion and abandon the condition of being insufficiently active or sedentary. Another point that should be highlighted is that only the basic and instrumental daily life activities are not enough for this population to benefit from the effects of physical activities on the muscular and skeletal systems.

The duration of physical activity has a great influence on body posture and balance[31] and, in this study, the elderly had practiced physical activity for at least six months. The profile of the elderly is changing and current studies on the posture of this population are scarce, which shows the demand for more longitudinal research on the impact of different types of physical exercises on postural alignment. Thus, professionals who work with the elderly should seek to develop and/or encourage the practice of dancing, among other physical activities, to stimulate the physical and mental health of the elderly.

Some limitations of this study must be mentioned. The first limitation was that the total physical activity time of PG was not quantified. The absence of specificity of the modality, intensity and frequency of the physical activities performed by the participants is

also an important limitation since these variables can influence the evaluation results. It was also not possible to determine whether the group that practiced physical s activities already had, before the evaluation, a more adequate postural alignment compared to those who do not practice. A third limitation refers to the fact that clinical conditions, such as osteoarthritis, were not investigated and could have interfered with the results. Finally, it is noteworthy that the elderly of the NPG were involved in elderly social groups (groups that offer activities and practices that stimulate the elderlies' health and social life), which may also have contributed to the lack of significant statistical differences between some variables of postural evaluation. In these groups, certain activities practiced requiring the recruitment of different muscles that act both in static and dynamic postures.

Despite the presented limitations, this study highlights the need for regular physical activity and that only the daily activities alone are not enough to maintain the balance and body posture of this population.

Conclusions

The results of this study point that the elderly who practice physical exercises have better sitting posture, vertical alignment, and balance, compared to those who do not regularly practice physical activities. This information can be useful to increase and encourage programs of body practices and physical exercises for the elderly in Brazil.

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